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Effect of helminths on the amino acid and lipid status of freshwater fish

by S.D. Gur'yanova

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One of the methods by which we can determine the individual aspects of the highly complex interrelations of parasite and host is the comparison of the biochemical status of helminth-free and helminth-infested tissues of the host. This approach can prove interesting in that it provides information about the food requirements of the helminth and the potential harm that it can inflict on the host.

The given report contains comparative data on the lipid and amino acid composition of the liver and other tissues of fish (stickleback, hake) free of plerocercoids and fish infested with them.

It has been shown that the presence of helminths is accompanied by a significant decrease in the total content of free (nonprotein) amino acids (2-fold in stickleback and 1.5-fold in hake), the decrease in essential amino acids of the liver being especially great (4-fold in stickleback and 2.5-fold in hake). Among other

things, we observed a decrease in the content of free arginine and lysine (by 61%), isoleucine (by 70%), leucine (by 32%), valine and methionine (by 67%), histidine (by 44%), threonine (by 85%) and phenylalanine (by 60%) in the liver of stickleback. The change in the content of essential amino acids in hake liver was approximately the same. It is interesting to note that the ratio of amino acids in the protein hydrolysates of the infested tissues did not change. Similar to the free amino acids, the total content of phospholipids decreased substantially in the helminth-infested liver of stickleback (to 21% as compared with 26% in uninfested fish); in highly infested hake, both the content of phospholipids and the content of triacylglycerol decreased in the liver (by nearly 50% and by 20% respectively). The content of total phospholipids and free amino acids also decreased in other tissues (muscles, intestine) when they became infested with helminths. The effect of helminths on the ratio of some lipids (primarily phospholipids) in the liver of the host was particularly great. In helminth-infested tissues, we observed, among other things, a sharp increase in the relative proportion of lysophosphatidal choline (from 1.2 to 10-13%) with a corresponding decrease in the proportion of phosphatidal choline. It should be said that the content of other individual phospholipids (sphingomyelin, phosphatidal ethanolamine and cardiolipin) is affected to a smaller extent.

Therefore, any change in the content of free amino acids in the tissues of infested fish is definitely the result of parasitization. This is also confirmed by a comparison of the amino acid ratios in the tissues of the parasite and host. For example,

the content of essential amino acids in the plerocercoids D. latum (52.8%) is considerably higher than in the liver of hake (29.1% of all the amino acids). However, the selective absorption of essential amino acids by the helminth may be due not only to the characteristics of the parasite itself, but also to the inability of the host cell to compensate for the loss of essential amino acids at the same rate as for nonessential ones.

Apparently, the helminth also secretes some factor (possibly a specific phospholipase) into the host tissue, and this factor regulates the permeability of the cell membranes without destroying them entirely. An indication of this is the partial transformation of phosphatidal choline into lysophosphatidal choline in the infested tissues with the ratio of the other phospholipids remaining more or less unchanged. There must also be other factors which, on the basis of the principle of inverse relationship, do not allow this lysis of phospholipids that begins at the membrane level to turn into an irreversible necrotic process.